# Learning 'Under Fire': Israel's improvised military adaptation to Hamas tunnel warfare

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# Learning 'Under Fire': Israel's improvised military adaptation to Hamas tunnel warfare

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**ABSTRACT**
What organisational attributes enhance a military's ability to effectively adapt on the battlefield? Upon the outbreak of war in July 2014 between Israel and the Palestinian militant group Hamas, the Israel Defense Forces (IDF) encountered an expansive network of tunnels from which Hamas was launching large-scale assaults into Israel. This article illustrates that the IDF's ability to successfully adapt 'under fire' to this battlefield surprise was facilitated by several important attributes related to its organisational learning capacity: a dynamic, action-oriented organisational culture, a flexible leadership and command style, specialised commando units which acted as 'incubators' for learning and innovation, and a formal system to institutionalise and disseminate lessons learned.

Simmering violence between Israel and the Palestinian militant group Hamas based in Gaza escalated into a large-scale military conflict in the summer of 2014. Preceded by several tit-for-tat border incidents, the group's kidnapping and murder of three Israeli boys a month prior, and an escalation of Hamas rocket fire into Israel, the Israel Defense Forces (IDF) launched Operation 'Protective Edge' on 7 July 2014. The operation, which lasted for seven weeks, was the latest round of fighting in the long-running protracted conflict between both sides. Throughout the duration of the operation, partially due to its Western, democratic disposition and moral foundations, the IDF faced many challenges from Hamas's unconventional warfare. Based on lessons learned from previous rounds of fighting against Israel, Hamas's military system in 2014 was comprised of three pillars: persistent rocket fire, organisational survivability and tunnel warfare which would enable limited offensive incursions into the Israeli heartland. Hamas utilised its extensive arsenal of short and long-range rockets to target the Israeli civilian home front by raining down thousands of rockets onto Israeli towns. Hamas built extensive defensive fortifications within the urban fabric of Gaza in order to

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be able to militarily to endure bombardment by the Israeli Air Force. The group prepared its forces for urban warfare in the dense neighbourhoods of Gaza, laying booby-traps and explosive devices to target IDF forces entering the area. Hamas also enhanced its offensive tactics and developed 'commando' units to infiltrate Israel by land and sea. Most surprisingly for the IDF, Hamas had developed an extensive network of tunnels, with some designed to infiltrate large numbers of fighters into Israel to kill or kidnap soldiers and civilians. These infiltrations hoped to shock Israeli society and achieve tactical success by allowing Hamas to launch high-profile attacks against IDF rear units behind the front lines. As Hamas political leader Khaled Meshal said in a 2014 interview, 'In light of the balance of power which shifted towards Israel, we had to be creative in finding innovative ways. The tunnels were one of our innovations. As they say, necessity is the mother of invention'.[1]

How did the IDF troops on the ground deal with the battlefield surprise of Hamas's expansive tunnel network? Despite significant intelligence warnings, the IDF was operationally unprepared to deal with the extent of Hamas's sophisticated tunnels. In order to cope with the tunnel surprise, the IDF had to learn and improvise on the battlefield and come up with solutions 'under fire'. This article focuses on the experience of the IDF in its 2014 conflict with Hamas as a case study to illustrate how a military's capacity to learn and adapt to battlefield surprise is enabled by several vital organisational attributes which need to be developed and nurtured in all effective military organisations.

Brig. Gen. Meir Finkel, Head of the IDF's Dado Centre for Interdisciplinary Military Studies, lamented in a recent article in the IDF's official journal that the IDF 'failed to understand the significance of the tunnels before the operation'. Although the failure does not represent a systemic deficit in Israeli intelligence collection, the tunnel surprise highlighted the 'gap' that emerged between the extensive intelligence reports on the subject and the knowledge of units on the ground that had not internalised the threat nor prepared for it. Ultimately, Gen. Finkel noted that this 'gap' relates to the difference between having 'knowledge' of a threat and having an 'understanding' of a threat that was only internalised upon the outbreak of hostilities. Critically, the IDF misunderstood that the tunnels were not to be used by Hamas merely to enhance the group's survivability, but as a form of maneuver warfare and the central component of its ground operations. The IDF's understanding of the threat and the development of an operational response was only triggered upon entering Gaza, encountering battlefield friction, confronting the enemy on the ground and learning 'under fire'.[2]

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[1]Quoted in Adam Ciralsky, 'Did Israel Avert a Hamas Massacre?' *Vanity Fair*, 21 October 2014
[2]Brig. Gen. Meir Finkel, 'Operational Learning in the Opening of Combat: The Tunnel Offensive in Operation "Protective Edge"', *Maarachot* no. 457 (Oct. 2014), 16–17 [Hebrew]

The great military theorist Carl von Clausewitz characterised friction as the unforeseen effects produced amidst the chaos of war and the 'only concept that more or less corresponds to the factors that distinguish real war from war on paper'.[3] Relatedly, IDF commanders generally characterise friction as what emerges during an encounter with an opponent on the battlefield.[4] Clausewitz noted:

> We have identified danger, physical exertion, intelligence and friction as the elements that coalesce to form the atmosphere of war, and turn it into a medium that impedes activity…Is there any lubricant that will reduce this abrasion? Only one, and a commander and his army may not have it readily available: combat experience.[5]

Only with combat experience obtained after battlefield engagement can a military force learn how to cope with friction and devise battlefield solutions. There has been little attention to understanding how IDF troops overcame battlefield surprise and adapted to the unexpected challenge of Hamas's tunnels. This article assesses how the IDF devised solutions in response to the shock of Hamas's expansive tunnel network, which was only triggered after the opening of conflict and encountering the tunnels on the ground. It assesses the vital lesson-learning processes that occurred during the war by soldiers in real-time on the battlefield. It focuses less on the highly classified tactical methods and technical procedures the IDF developed for underground warfare, and more on the vital organisational attributes that enhanced the IDF's capacity to learn as well as the mechanisms for lesson-learning used to adapt to the battlefield surprise.

## A battlefield surprise? Israel's pre-war intelligence on the tunnel threat

Tunnelling is not a new phenomenon in Middle Eastern warfare, as the IDF top brass were well-aware of Hamas's use of tunnels for smuggling goods and weapons into the Gaza Strip since the 1980s and 1990s.[6] IDF Military Intelligence officials explicitly warned on numerous occasions after the outbreak of the Second Intifada in 2000 about the threat from Hamas's use of tunnels for offensive attacks. The Head of IDF Southern Command (which is responsible for Gaza) publicly wrote about the pronounced threat from tunnels in 2004 and also noted that in previous efforts to contain the threat, the IDF had destroyed more than 94 smuggling tunnels in Gaza's Rafah

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[3]Carl von Clausewitz, in Michael Howard and Peter Paret (eds.), *On War*, (Princeton: Princeton UP, 1976), 119
[4]Finkel, 'Operational Learning in the Opening of Combat,' 17
[5]Clausewitz, *On War*, 122
[6]Eado Hecht, 'Hamas Underground Warfare', Perspectives Paper no. 259, BESA Center for Strategic Studies, 27 Jul. 2014.

border region between September 2000 and January 2004.[7] In the two decades preceding the 2014 conflict, IDF technology experts had been rigorously experimenting with hundreds of systems that monitor underground movement by utilising seismic and geophysical sensors, complex algorithms, underground microphone systems to detect digging, land penetrating radar and micogravity radiation, apparently with limited success.[8]

Lt. Gen. Moshe Yaalon, the IDF Chief of Staff at that time, (who also happened to be the defense minister during the 2014 operation), was briefed by IDF Military Intelligence on the severity of the tunnel threat after a high-profile incident in May 2004 where five IDF soldiers that were sent to destroy three Hamas smuggling tunnels uncovered along the Gaza-Egypt border were ambushed and killed. In response, the IDF launched an operation in late May 2004 (Operation 'Rainbow') designed to target Hamas weapons smuggling tunnels, and during the operation, discovered several tunnels booby-trapped with explosives and others with entrance shafts concealed within residential structures in Rafah (an ominous precursor of things to come).[9]

In a 2004 internal intelligence report, Col. Yossi Langotsky, an IDF intelligence officer and army geologist, in consultation with former Deputy Chief of Staff Maj. Gen. Amir Drori, also a geologist by training, noted that Hamas tunnels should be considered a strategic threat because they were 'multi-layered, long-range, multisector and made of various kinds of rock; at this stage in Gaza and on the Lebanese border, at a depth of up to 25 m and a length of hundreds of meters, even kilometres. The vertical and horizontal maneuvering ability of the tunnel-diggers is great, and they are capable of evading the checkpoints placed on the roads by descending and then ascending.'[10]

Clearly by 2004, top army echelons were made explicitly aware of the tunnel threat. Hamas's tunnel infrastructure received further attention after the well-known kidnapping of IDF Cpl. Gilad Shalit in June 2006, where Hamas militants infiltrated 100-meters into Israel via a tunnel, ambushed an IDF post and killed two soldiers, while kidnapping Cpl. Shalit (which resulted in his five years in Hamas captivity). Despite intelligence warnings and such well-publicised attacks, organisational inertia led the IDF to downplay Hamas's capabilities, bureaucratic obfuscation led to internal wrangling

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[7]Doron Almog, 'Tunnel-Vision in Gaza' *Middle East Quarterly* 11/3 (Summer 2004), 3–11

[8]Avi Bar-Eli, 'Millions Down the Tunnel: How Israel Botched the Battle Against Hamas' *Haaretz*, 21 July 2014; Inbal Orpaz, 'Israeli High-Tech is Great, but Not Yet for Finding Hamas Tunnels' *Haaretz*, 24 July 2014; Yiftah Shapir and Gal Perel, 'Subterranean Warfare: A New-Old Challenge' in Anat Kurz and Shlomo Brom, (eds.), *The Lessons of Operation Protective Edge*, (Tel Aviv: INSS, 2014), 51–57.

[9]Israel Ministry of Foreign Affairs, 'Weapons Smuggling Tunnels in Rafah: Operation Rainbow', 17 May 2004.

[10]Amir Oren, 'How the Israeli Defense Minister Failed to Address the Threat from Below' *Haaretz*, 22 July 2014.

over the funding of a technological solution, and the outbreak of the 'more urgent' war in 2006 with Hizbullah in Lebanon led to a central focus on the rocket threat, which all contributed to hindering the development of an adequate strategic or technological response to the tunnels. Since IDF Military Intelligence was well-aware of the tunnel phenomenon for more than a decade prior to the 2014 Gaza conflict, Hamas's tunnel infiltrations should not be viewed as a surprise per se. However, the size, scope and complexity of Hamas's extensive network of tunnels were a strategic surprise for the IDF. Upon the outbreak of hostilities in 2014, tunnels were discovered which breached several hundred meters into Israeli territory towards the outskirts of border villages, and some were more than 90-meters deep with multiple branches, shafts and exits concealed within the civilian infrastructure in Gaza. For Israeli soldiers operating on the ground with little exposure to the operational challenges of tunnel warfare, this was indeed a battlefield surprise. Regardless of the pre-war intelligence on the tunnels, as Sir Michael Howard famously remarked, '…It does not matter that they have gotten it wrong. What does matter is their capacity to get it right quickly when the moment arrives'.[11]

## Military adaptation and 'organisational learning capacity'

As retired Chairman of the US Joint Chiefs of Staff Gen. Martin Dempsey wrote, 'There are no crystal balls that can predict the demands of future armed conflict. That is why I believe our ability to learn and adapt rapidly is an institutional imperative'.[12] For our purposes, an adaptation 'involves adjusting existing military means and methods', while an innovation 'involves developing new military technologies, tactics, strategies and structures'.[13] Notably, adaptation should not be considered 'less significant' than innovation, as adaptation 'can add up to significant change in a military's capabilities or approach to operations.'[14]

Western militaries engaged in complex operations have sought ways to encourage initiative, flexibility and agility in an effort to cope with the inherent friction of war. The US Department of Defence's 2014 Quadrennial Defence Review noted the central importance of 'infusing a culture of innovation and adaptability' as 'innovation is paramount given the increasingly complex war-fighting environment we expect to encounter.'[15] British army doctrinal documents have highlighted Israel's wars with Hamas (as well as its 2006 war with

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[11]Michael Howard, 'Military Science in an Age of Peace', *RUSI Journal* 119/1 (1974), 7.
[12]Martin Dempsey, 'A Dialogue about our Army: A Campaign of Learning to Achieve Institutional Adaptation' *Army Magazine* 60/11 (Nov. 2010), 35.
[13]Theo Farrell and Terry Terriff, 'Sources of Military Change', in idem, (eds.), *The Sources of Military Change: Culture, Politics, Technology* (Boulder: Lynne Rienner 2002), 6.
[14]Theo Farrell, 'Introduction: Military Adaptation in War' in Theo Farrell, Frans Osinga, James Russell, (eds.), *Military Adaptation in Afghanistan*(Stanford: Stanford UP 2013), 6–7.

Hizbullah in Lebanon) to be indicative of what future conflict for Western armies will look like, and lessons learned from Israel's battlefield experiences have informed the British army's efforts to improve its adaptability and organisational agility. The MOD's 2010 *Future Character of Conflict* specifically described the 'congested' and 'cluttered' battlefield of Gaza where militants were enmeshed amongst the civilian population to be emblematic of the operational challenges facing conventional armies. It presciently noted, several years before the extent of Hamas's tunnel network became fully known that based on lessons from Gaza and elsewhere, 'the enemy will develop and exploit underground facilities.'[16] As exemplified in the experiences of the IDF in its 2014 war with Hamas, the operational environment is overshadowed by fog and friction that can only be managed by real-time organisational learning and adaptation.

What organisational attributes enhance a military's ability to effectively learn, adapt and respond to unexpected challenges? According to a new framework developed by Lt. Col. (ret.) Frank Hoffman, a military's 'organisational learning capacity' and ability to successfully adapt is facilitated by several important attributes: organisational culture, leadership and command style, a learning mechanism and a means to disseminate lessons.[17] Culture consists of 'the beliefs, symbols, rituals and practices which give meaning to the activity of an organisation' and influences perceptions of 'the optimal means to fight wars'. It shapes organisational norms and choices, impacts preferences and actions and sets the context for how organisations view problems and establish solutions.[18] As a key attribute of a military's learning capacity, culture sets the context for all organisational change and affects factors that influence adaptation, including civil-military relations, leadership style, organisational structures and institutional dynamics.[19]

Cultural factors have been identified that promote or hinder organisational exploration of new approaches in wartime. For example, Foley noted that adaptation by the German army in the First World War was shaped by its pre-war organisational culture that emphasised formal education and was furthered by the leadership that encouraged systematic learning at lower levels of the organisation. This also occurred through the use of after-action reports which enabled incremental, formulised change.[20] Elsewhere,

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[16]Ministry of Defence, *Future Character of Conflict, Strategic Trends Programme* (Shrivenham: DCDC, Feb. 2010), 18–19, 22.

[17]Frank G. Hoffman, 'How We Bridged a Wartime Learning Gap' *US Naval Institute Proceedings* 142/5 (May 2016), 22-29.

[18]The definition draws from Jeffrey Legro, 'Military Culture and Inadvertent Escalation in World War II', *International Security* 18/4 (Spring 1994), 109; Theo Farrell, 'Culture and Military Power', *Review of International Studies* 24/3 (July 1998), 410.

[19]Theo Farrell, 'The Dynamics of British Military Transformation', *International Affairs* 84/4 (July 2008), 777–807; Dima Adamsky, *The Culture of Military Innovation* (Stanford: Stanford UP 2010).

Farrell noted that in the late 2000s, cultural factors related to skepticism of the benefits of technology hindered the British army's 'transformation' to networked command and control systems.[21] In the British army's recent Afghanistan campaign, a short organisational memory, a decentralised command structure and a rapid rate of personnel turnover made the army more likely to explore new concepts related to counterinsurgency (but such cultural factors also caused significant problems related to institutionalising change).[22]

The second attribute of a learning organisation is a leadership style that is open and dynamic which improves its ability to learn and adapt. Shaped by its culture, effective learning organisations adhere to 'mission command' (*Auftragstaktik*), which is the command philosophy where officers grant significant autonomy and operational independence to subordinates to achieve the overall mission set out by the senior command. Perfected by the famous Prussian general Helmuth von Moltke the Elder, due to an understanding of the chaos that emerges and friction in war, soldiers are told what to do by their commander, but not how to do it, as a large portion of the mission is dictated by soldiers on the ground. This genius leadership style allowed for local initiative and adaptation while ensuring unity of purpose, as the army was able to enjoy the benefits of decentralisation while maintaining overall control.[23]

An adaptive military organisation must have mechanisms to assist soldiers in organisational problem-solving.[24] Avenues for experimentation and risk-taking in a non-punitive environment are a critical vehicle for encouraging adaptation and are a vital attribute of a learning organisation. A key mechanism for military adaptation has been the use of experimental units which act as 'incubators' of innovation and a driving force for organisational adaptation. Special Forces are often the units where new technologies, doctrines and practices are initially implemented and tested, which after refinement and improvement, may be disseminated to regular formations.[25] For example, the German army in the First World War had great success with specialised experimental units to problem-solve, formally teach officers how to respond to battlefield challenges and rapidly share lessons learned, which eventually led to creation of new doctrine.[26] The US Army also utilised 'incubators' as institutional facilitators when developing new doctrine,

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[21]Farrell, 'The Dynamics of British Military Transformation', 788–9.

[22]Theo Farrell, 'Improving in War: Military Adaptation and the British in Helmand Province, Afghanistan, 2006–2009', *Journal of Strategic Studies* 33/4 (Aug. 2010), 572–3; For a critical assessment of why learning was inhibited in lower-level tactical units, Sergio Catignani, 'Getting COIN at the Tactical Level in Afghanistan: Reassessing Counterinsurgency Adaptation in the British Army', *Journal of Strategic Studies* 35/4 (Apr. 2012), 513–39.

[23]Eitan Shamir, *Transforming Command: The Pursuit of Mission Command in the US, British, and Israeli Armies* (Stanford: Stanford UP 2011), 29–41.

which provided a 'safe' space for experimentation and enabled the construction of new operational concepts.[27]

Lastly, a dissemination mechanism to codify and transmit lessons learned to units is an essential component of a learning organisation. Soldiers on the ground have an increasingly pivotal role in triggering and shaping all military change.[28] Innovation from the 'bottom-up', and 'horizontally' between units, is most likely in an organisation with a weak central doctrine, many informal networks between officers, a lack of 'ownership' of ideas, a non-punitive, collaborative learning culture and a means to formulise lessons.[29] As the British and American army's experiences in Afghanistan and Iraq illustrate, by institutionalising bottom-up learning through formal channels and battlefield knowledge management programs, modern militaries are increasingly able to learn and adapt on the ground at a more rapid pace.[30] Moreover, if bottom-up adaptations are not formally institutionalised within the organisation, these hard-earned lessons are lost and will have to be relearned again in the future, often at higher and bloodier cost.[31]

This article demonstrates that the IDF's effective adaptation 'under fire' to the Hamas tunnel surprise was enabled by each of these prized attributes which characterise highly successful learning organisations: First, the IDF's open, dynamic organisational culture and action-oriented 'doer' mentality has historically encouraged learning in conflict and enabled effective adaptation. The IDF's decentralised command style which emphasises the autonomy of its soldiers on the ground (mission command) enhanced its learning capacity. Facilitated by a traditional proclivity for practical solutions and learning on-the-go, in the years prior to the war, the IDF also built an innovative training regimen that emphasised flexibility and how to effectively cope with and respond to battlefield surprise. Second, the IDF's learning was spearheaded by commando units that specialised in counter-tunnel warfare and acted as 'incubators' for experimentation and innovation and were able to develop solutions to 'pull' the rest of the army up to speed on underground warfare. New operational and tactical methods devised on the battlefield were horizontally transmitted between units operating in Gaza through informal networks. These improvised adaptations were also formally diffused throughout the organisation from the bottom-up using

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[27]Benjamin Jensen, *Forging the Sword: Doctrinal Change in the US Army* (Stanford: Stanford UP 2016).

[28]Adam Grissom 'The Future of Military Innovation Studies', *Journal of Strategic Studies* 29/5 (Oct. 2006), 926–27.

[29]Robert Foley 'A Case Study in Horizontal Military Innovation: The German Army 1916–1918', *Journal of Strategic Studies* 35/6 (Dec. 2012), 799–827; Farrell, 'Improving in War', 572–3.

[30]Robert Foley *et al.*, 'Transformation in Contact: Learning the Lessons of Modern War', *International Affairs* 87/2 (Mar. 2011), 253–70; Catignani, 'Getting COIN', 517; James Russell, *Innovation, Transformation, and War: Counterinsurgency Operations in Anbar and Ninewa Provinces, Iraq 2005–2007* (Stanford: Stanford UP 2010).

[31]Sergio Catignani, 'Coping with Knowledge: Organizational Learning in the British Army?' *Journal of Strategic Studies* 37/1 (2013), 30–64.

the IDF's 'knowledge management' lesson-learning system and were eventually institutionalised by the IDF command from the top-down. This method of disseminating lessons learned resembles an institutionalised method of Israeli military adaptation, a desirable element in any effective military organisation facing agile adversaries who utilise unconventional methods. Additionally, the IDF informally toyed with the innovative concept of launching 'learning operations', where a small number of units were encouraged to enter Gaza, not to fight per se, but rather to engage Hamas and to elicit a reaction from which the IDF could learn, adapt and devise a response.

## The IDF's response to the tunnels

In response to an escalation in Hamas rocket fire on the Israeli civilian front, Israel launched a large-scale air and artillery campaign against Hamas which commenced on 7 July. Israel's initial strategic goal was to demonstrate to Hamas the 'steep price' it would have to pay for attacking Israel, which would deter Hamas from future action, ensure a period of calm and defer the next round of fighting.[32] While the Israeli Air Force's destructive firepower significantly damaged Hamas's military and command infrastructure, Hamas still maintained the ability to launch rockets and embark on ground incursions. Due to Hamas's emphasis on organisational survivability and resilience, Hamas militants hunkered down in bunkers embedded amongst the civilian fabric of the Gaza Strip were able to endure Israel's air campaign and precision firepower, while militants used the system of tunnels to move throughout the Strip and to launch offensive incursions into Israel.

Based on its lessons learned from previous rounds of fighting, Hamas sought to gain strategic initiative by surprising Israel with its firing of long-range rockets deep into civilian areas (threatening Jerusalem, Tel Aviv and Israel's main airport) and by launching seaborne commando assaults and tunnel infiltrations, all part of the group's strategy of psychologically exhausting Israeli society.[33] Hamas launched several incursions to infiltrate Israel via these 'attack tunnels' (as they became known in Israel) to kill or kidnap unsuspecting IDF soldiers or civilians. Hamas militants emerged from tunnel openings inside Israel, meters away from Israeli villages, kibbutzim, and army guard posts. On 17 July, a 13-member Hamas squad emerged at dawn from a tunnel in a field on the outskirts of the Israeli kibbutz Sufa before being detected by various sensors and neutralised by an IDF drone. The dramatic drone footage of the Hamas militants popping out of the

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[32]Udi Dekel, 'Operation Protective Edge: Strategic and Tactical Asymmetry', in Anat Kurz and Shlomo Brom, (eds.), *The Lessons of Operation Protective Edge* (Tel Aviv: INSS, 2014), 14.

[33]Eitan Shamir and Eado Hecht, 'Gaza 2014: Israel's Attrition versus Hamas Exhaustion', *Parameters* 44/4 (Winter 2014–15), 81–90; Dekel, 'Operation Protective Edge', 16.

ground and moving stealthily around Israeli territory was broadcast on Israeli television and shocked Israeli society.[34] IDF Chief of Staff Lt. Gen. Benny Gantz later remarked that 'the incident at Sufa made the penny drop for us' on the need for a ground incursion to deal with the tunnel threat.[35]

It seems the IDF initially launched Operation 'Protective Edge' as a 'time-limited operation to restore deterrence', which was the same strategic rationale of previous rounds of fighting with Hamas. After the shock of the Sufa incident, the IDF was forced to adapt its initial strategy to deter Hamas and began a focused effort to remove the grave threat posed by the Hamas tunnels.[36] On 17 July, the IDF launched a limited ground campaign, where the army planned to enter 2 km into the Gaza Strip to destroy approximately three dozen Hamas tunnels that were assessed to be infiltrating Israel. The Israeli air force also launched strikes against more than 200 additional 'storage tunnels' within Gaza itself.[37] However, Hamas continued to infiltrate commando teams into Israel via tunnels throughout the IDF's ground campaign. Hamas units infiltrated via tunnel near Kibbutz Beeri (19 July) and killed 2 soldiers. A 10-man Hamas cell disguised in IDF uniforms infiltrated Israel via a tunnel and split up to simultaneously attack the villages of Niri-Am and Erez (21 July). The militants managed to kill 4 soldiers before being neutralised. Another dramatic attack occurred on 28 July when a Hamas cell emerged from a tunnel, raided an IDF post and killed 5 unsuspecting soldiers on the outskirts of Nahal Oz. Hamas later released graphic footage of the ambush, which was broadcast on various media stations. Overall, tunnels resulted in the deaths of more than 11 IDF soldiers inside Israel and the capturing of the bodies of two soldiers killed-in-action.

Upon entering Gaza, most ground troops encountered Hamas's sophisticated network of tunnels and underground bunkers face-to-face for the first time. The destruction of these tunnels was the main goal of the ground operation set out by the Israeli political echelon, especially since the size and scope of the tunnel system had become evident to the Israeli public. IDF soldiers encountered a complex network of long, wide tunnels fortified with concrete, with shaft openings embedded within Gaza mosques, schools, residential complexes and in one case, a hospital.[38] IDF Military Intelligence assessed that compared to the smuggling tunnels previously encountered, these tunnels were built for Hamas offensive operations and

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[34]For footage of the strike, Israel Defense Forces, 'Footage of Hamas Terror Attack Being Thwarted', 17 July 2014, available on YouTube.

[35]Amos Harel and Gili Cohen, 'Haaretz Probe: IDF Lacked Training, Equipment to Tackle Tunnels in Gaza', *Haaretz*, 17 October 2014.

[36]Dekel, 'Operation Protective Edge', 14; also, Amos Yadlin, 'The Strategic Balance of Operation Protective Edge', in Anat Kurz and Shlomo Brom, (eds.), *The Lessons of Operation Protective Edge* (Tel Aviv: INSS, 2014), 203.

[37]Eado Hecht, 'The Tunnels in Gaza', Testimony to the United Nations Commission of Inquiry on the 2014 Gaza Conflict, (Feb. 2015), 9–15.

[38]Klaus Naumann *et al.*, *An Assessment of the 2014 Gaza Conflict*, (High-Level Military Group, Oct. 2015), 45–7; 'Hamas Uses Hospitals and Ambulances for Military Purposes', *IDF Official Website*, 28 July 2014.

were designed to enable the potential infiltration of hundreds of Hamas fighters into Israel to launch a large-scale strategic ground maneuver to kill Israelis. Despite this pressing threat, the IDF had insufficient training in underground warfare prior to the war.

Brig. Gen. Nadav Padan, the seasoned commander of the 162nd Division (one of the three divisions that entered Gaza) described the surprise outbreak of conflict and the IDF's prior training for tunnel warfare, based largely on Hizbullah's bunkers and underground passages encountered in Lebanon during the 2006 war:

> We began preparations for an attack on the tunnels before the operation in Gaza. Some of the combat drills were developed beforehand. In mid-July [2014], a program was prepared for the Gaza Division, to be led by the Givati Brigade, designed to train for underground combat. But the war broke out a week before the program was to take place. In the end, we had the real thing – against Hamas. [39]

In the absence of formal operational or tactical procedures for tunnel warfare, the IDF was forced to improvise, as all armies do when coping with battlefield friction and surprise. In an exposé in an Israeli newspaper on the IDF's response to the tunnel threat, soldiers explained that the first time they ever experienced blowing up a tunnel was in the field. Despite prior intelligence, highlighting the surprise felt by some soldiers on the ground and the improvisation that was required after encountering the tunnel surprise first-hand, a reservist in the IDF Combat Engineering Corps who fought during the war said: 'No one knew, and no one had planned in advance how to deal with the tunnels. Nearly everything was done in a spontaneous way in the field'.[40]

Gen. Padan, the division commander, explained in a 2014 interview that his soldiers internalised the threat only *after* coming under fire and were only then able to devise a response:

> I travelled to the Northern Command, to learn about Hezbollah's defensive tunnels from the war in 2006. The tunnels didn't surprise us, but they included an element that's unknown until you see it for yourself. It's like the difference between learning driving theory and getting behind the wheel yourself […] We got into the war with only a moderate ability to deal with the tunnels. That improved during the fighting, and we learned a great deal.[41]

## Organisational culture and mission command

The IDF's improvised response to the Hamas tunnels relied on a mode of adaptation imbued in Israel's action-oriented military culture. The IDF's capacity

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[39]Amos Harel, 'Top General in Gaza War: We Could Have Retaken the Strip', (Interview with Brig. Gen. Nadav Padan), *Haaretz*, 10 October 2014.
[40]Harel and Cohen, 'Haaretz Probe'.
[41]Harel, Interview with Brig. Gen. Nadav Padan.

to learn is reliant on its flexibility as an organisation and the qualitative edge of the individual soldier, grounded in distinctive Israeli cultural values which emphasise initiative, out-of-the-box thinking and tenacity.[42] Improvisation and flexibility have historically been encouraged in IDF culture, as troops are traditionally expected to autonomously devise tactical solutions under fire with little oversight from commanders, in line with 'mission command' principles. While improvisation and learning on-the-go may counteract a military organisation's desire for methodical planning, order and systematic adherence to plans or regulations, such organisational traits are prized attributes of the IDF.[43]

Organisational culture is formed and constituted by discourses and narratives which are generally centred around key historical events, circumstances and individual personalities which come to embody particular characteristics to be followed and emulated. Certain operational experiences and iconic behaviour shapes organisational culture and influences operational preferences.[44] The legendary experiences in the IDF's formative years of bold, young commanders leading from the front, learning on-the-go, improvising under fire and autonomously creating new tactics from the bottom-up are imbued within its strategic culture and organisational memory. The early experiences of famed tenacious commando units led by iconic figures in Israeli history are viewed as the 'gold standard' for adaptation and problem solving and embody the IDF's 'doer' ethos and action orientation.[45] This has led to the IDF's consistent emphasis on the autonomy of its soldiers on the ground, whose creativity and audacity are actively encouraged by commanders to solve the immediate battlefield problems without the need for consultation with the high command.[46] The IDF's decentralised command and control system and its dynamic organisational culture promotes officer initiative and autonomy, creative thinking, risk taking, problem solving and improvisation.[47] There is also a solid comprehension of the toxic effect that micromanagement has on stifling innovation. Personifying this valued cultural trait, General Moshe Dayan famously said, 'I prefer excessive initiative and action, even if it involves some mistakes here and there, to the passivity of "sit and do nothing" and covering yourself with paper and seven authorisations for an operation before its execution'.[48]

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[42]Adamsky, *The Culture of Military Innovation*, 110–25.

[43]Uzi Ben-Shalom and Eitan Shamir, 'Mission Command between Theory and Practice: The Case of the IDF', *Defense and Security Analysis* 27/2 (June 2011), 101–17.

[44]Terry Terriff, 'Warriors and Innovators: Military Change and Organizational Culture in the US Marine Corps', *Defence Studies* 6/2 (June 2006), 217–18.

[45]Raphael D. Marcus, 'Military Innovation and Tactical Adaptation in the Israel-Hizballah Conflict: The Institutionalization of Lesson-Learning in the IDF', *Journal of Strategic Studies* 38/4 (2015), 504–8.

[46]For a critical view on the negative impact of these cultural traits, Gil-li Vardi, 'Pounding Their Feet: Israeli Military Culture as Reflected in Early IDF Combat History', *Journal of Strategic Studies* 31/2 (April 2008), 295–324.

[47]Shamir, *Transforming Command, 83–85*; Dan Horowitz, 'Flexible Responsiveness and Military Strategy: The Case of the Israeli Army', *Policy Sciences* 1/2 (Summer 1970), 191–205.

At a press conference on the Gaza border in early August 2014 in the midst of the conflict, Chief of Staff Lt. Gen. Benny Gantz deflected criticism that the IDF was surprised by the tunnel threat and instead praised the improvisation of the soldiers on the ground. Illustrating the importance of battlefield friction in triggering adaptation, Gen. Gantz said that while IDF Military Intelligence was 'exceptionally good', he noted that for troops on the ground 'Yes, it was necessary to improvise and innovate during fighting, in real time, but that's how war is'.[49]

Along these lines, Gen. Padan, the division commander, described the learning that occurred during the operation, as units devised responses to Hamas tunnels after encountering the threat on the battlefield: 'We were familiar with the tunnels mainly in theory. We did not have operational experience. There is something in the friction, in the experience, that accelerates understanding. We internalised it all only while dealing with the tunnels.'[50]

A chief reason that the IDF was able to respond effectively to battlefield surprise was due to the implementation of an innovative training regimen in the years prior to the 2014 Gaza conflict. In 2011–2012, the IDF implemented several programs to ensure that the Ground Forces maintained an appropriate balance in their mission orientation and training regimen in order to be able to fight effectively in both major combat operations and low-intensity warfare. This program reflected a lesson learned after the IDF's inappropriate operational focus prior to the 2006 Lebanon War and the army's mediocre ability to deal with Hizbullah's mode of warfare.[51] The IDF developed and adopted a training regimen which was compatible with the IDF's culture and emphasised operational flexibility, adaptation, risk-taking and rapid learning. Instead of futilely attempting to predict the nature of future war or devise plans for all contingencies based on (imperfect) intelligence, the IDF built a training program to challenge commanders on mental, cognitive and physical issues related to responding to inevitable battlefield surprise. The starting position for the unit in the training exercise is battlefield 'shock', or doctrinal or technological surprise, and commanders focus on the processes of recovering from surprise or failure, in order to learn how to cope with friction and adapt.[52] This little-known but highly innovative training regimen had a major contribution to enabling the effective response of IDF troops to the Hamas tunnel surprise.

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[49]Gili Cohen, 'IDF Chief of Staff: Hamas Leaders to Blame for "Devastating" Results of Gaza Fighting', *Haaretz*, 6 August 2014.

[50]Harel and Cohen, 'Haaretz Probe'.

[51]For more on the IDF's pre-2006 operational focus, Raphael D. Marcus, 'The Israeli Revolution in Military Affairs and the Road to the 2006 Lebanon War', in Jeffrey Collins and Andrew Futter, (eds.), *Reassessing the Revolution in Military Affairs: Transformation, Evolution, and Lessons Learnt* (Basingstoke: Palgrave-Macmillan, 2015), 92–111.

[52]Author interview with Brig. Gen. Meir Finkel, (Glilot base, Israel), 2 November 2015.

## 'Incubators' of learning and innovation: IDF commando units

When faced with battlefield surprise, the IDF relied on its ability to improvise and fell back on a mode of military adaptation that is engrained in its organisational memory. Historically, once the IDF identifies a battlefield problem, the actual process of tactical innovation is spearheaded by specialised commando units which are created to solve the IDF's immediate battlefield challenges and have historically acted as 'incubators' for operational experimentation and innovation. This is why hyper-specialised units are abundant in the IDF, ranging from counter-IED units, urban warfare units, counter-guerilla warfare units, counter-terrorism units, checkpoint units and even a camel patrol meant to specialise in desert reconnaissance. The IDF's informal leadership style, 'flat' hierarchy and open command culture are crucial factors in encouraging creativity and adaptation by these specialised units from the bottom-up.

The 'Yahalom' Unit (trans.: diamond), an abbreviation for the 'Special Operations Engineering Unit', part of the IDF Combat Engineering Corps, was the main unit with an expertise in underground warfare and demolition. Within the unit, the 'Samur' Company (trans.: weasel) was specially trained in operating in and searching for tunnels (similar to the US Army's famed 'Tunnel Rats'). This unit was bolstered after the 2006 Lebanon War, partially based on the IDF's wake-up call on the ground in Lebanon after it encountered Hizbullah's bunkers in the dense bushy terrain of south Lebanon that were resilient to IDF air strikes. Two years before the 2014 conflict, a commanding officer in the Yahalom unit remarked that 'As experts in the field, we "wrote the book" explaining how to locate a terrorist tunnel, how to access it and if necessary how to neutralise any terrorists and/or explosive threat.'[53]

As the IDF's tunnel specialists, when the Yahalom unit was faced with the complexity and sophistication of Hamas's concrete-reinforced tunnels in 2014, the unit improvised and developed solutions for how to destroy the tunnels which were longer, wider and deeper than those previously encountered. The counter-tunnel unit was meant to lead the way and 'pull' the rest of the army up-to-speed regarding underground warfare and demolition. Describing the IDF's traditional reliance on commando units to solve urgent problems, Col. (res.) Atai Shelach, a former commander of the Yahalom Unit, noted that 'Various units were established over the years in response to operational needs and to organisational conditioning' in order to 'provide specialised solutions, which eventually evolved into professional solutions.'[54]

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[53]'IDF Elite Unit Combats Hamas Smuggling Tunnels', *IDF Official Website*, 2 July 2012.
[54]Atai Shelach, 'The IDF's New Commando Brigade: Evolution, Not Revolution', *Israel Defense Magazine*, 27 October 2015.

Numerous challenges existed for ground units carrying out counter-tunnel operations, whose missions included: searching and locating tunnel entrances and exits, assessing whether a tunnel is for offensive or defensive purposes, checking the tunnel for explosives, weapons or booby traps (or digging a new parallel entrance to avoid possible booby-traps altogether) and mapping the full length of the tunnel and any ancillary shafts or branches. Once the tunnel was mapped, units had to clear the tunnel of booby-traps and any Hamas fighters that soldiers might 'bump into' inside the tunnel. Soldiers then carried an average of 10 tons of explosives to tunnel entrances with minimal mechanical assistance (which made them highly vulnerable to Hamas fire, and hence required significant force protection). Then, engineering units rigged explosives throughout the entire length of the tunnel to a common detonator and finally carried out the controlled demolition of the tunnel with the overarching goal of preventing the tunnel from being rebuilt (while inflicting minimum damage above ground).[55]

According to Lt. Col. Roy Nahari, a battalion commander in the IDF Combat Engineering Corps who operated on the ground in Gaza during the 2014 conflict, the main difficulties related to subterranean warfare was first pin-pointing the location of the tunnel, ruling out the presence of booby-traps and explosive charges, and then erecting a protective setup to enable the army engineers to operate safely inside the tunnel. Describing the rapid adaptation necessary from the IDF's specialised units, Lt. Col. Nahari described the IDF's reliance on commando units to rapidly devise solutions:

> We had 24 hours to prepare for the tunnel mission…Our most important capability as the engineering forces is to come in and adapt a solution…From the moment the decision was made that we were not going to maximum depth [in a ground invasion of Gaza] but being assigned to deal with the attack or intrusion tunnels instead – we immediately made the adaptations in our task forces, as well as with regard to the professional capabilities in the context of the response we provided.[56]

A pivotal challenge facing the IDF was that the army's anti-tunnel warfare capabilities were too limited and the Yahalom unit was too small to handle the demolition of the 32 discovered tunnels at a rapid enough pace. In order to speed up the process to destroy the tunnels, the IDF called in other special forces units held in high esteem in the IDF, as well as additional ground units, even though none of these units had been trained specifically for tunnel warfare. Nevertheless, these units were expected to quickly learn about the problem, improvise a solution and carry out the mission to destroy the tunnels. They did not have the dedicated technical equipment of the Yahalom unit, but

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[55]Hecht, 'The Tunnels in Gaza', 24–25.
[56]'The Subterranean Medium has Become Part of the Future Battlefield', (Interview with Lt. Col. Roy Nahari), *Israel Defense Magazine*, 11 February 2015.

enabled by the IDF's culture and adherence to mission command, they adapted and improvised with the equipment they had available to achieve the task.[57]

Illustrating the utility of the other special forces units, the IDF's most elite commando force Sayeret Matkal acted as 'tunnel combat contractors' during the war. They used their own complex operating systems, special wiring and sophisticated communications equipment that functioned underground to develop improvised solutions to locate and secure tunnel openings. In fact, due to the effective use of these technologies by Sayeret Matkal, after the war the IDF disseminated these specialised technologies previously designated only for commando units to other ground forces for future use in counter-tunnel operations.[58] A downside was that the special forces' contribution to counter-tunnel operations came at the expense of their other unique skills and capabilities. Discussing the use of the IDF's various special forces units and ground units for these niche counter-tunnel missions, a former commander of the Yahalom unit cautioned that, 'The IDF and the special forces will be required, on the one hand, to maintain the basic skills required of each specialised unit, while on the other hand making the necessary adjustments and updates so that the IDF may possess the entire "toolbox" they may be called upon to employ in each and every conflict.'[59]

The Yahalom, as the sources of knowledge and 'incubators' of innovation, played a vital role in the IDF's institutionalised learning mechanism. Through formal and informal methods, the Yahalom horizontally transmitted best-practices and lessons to the other units facing similar operational challenges in an attempt to 'pull' the rest of the army up to speed for tunnel demolition.[60] For example, reservist officers who fought during the 2014 conflict explained how such specialised units transmitted lessons learned in the field: 'We learned while in motion. We received brief instruction from the Yahalom unit, and we blew up the tunnels with the help of chains of land mines…Our only experience had been accumulated blowing up buildings in Lebanon and Gaza, and that didn't resemble blowing up a tunnel.' In another example, a reserve battalion that had already blown up a tunnel in combat in 2014 was recalled from Gaza in order to receive a briefing from the Yahalom Unit at one of the IDF's main Ground Forces bases. One officer who attended the training said, 'At the end of the briefing, the company commander took us aside and said: "So that's how you really do it."'[61]

With the overall goal of destroying Hamas's offensive tunnel capability in mind, non-specialist IDF units autonomously improvised and developed tactical

[57]Author interview with a retired senior IDF officer, 27 May 2016.
[58]Yoav Zitun, 'IDF Unveils New Method for Destroying Terror Tunnels', *Yediot Ahronot*, 3 April 2015.
[59]Atai Shelach, 'Life is What Happens While Making Plans', *Israel Defense Magazine*, 8 March 2014.
[60]For an appraisal of formal and informal learning processes, Catignani 'Coping with Knowledge', 31–2; The term 'horizontal innovation' is elucidated in Foley, 'A Case Study in Horizontal Military Innovation', 802–4
[61]Harel and Cohen, 'Haaretz Probe'.

solutions independently of the high command, without extensive knowledge of the specialised procedures for demolition of Hamas's concrete-reinforced tunnels. These unit's improvisations were carried out in an effort to hasten the demolition process, since the speed that the IDF was destroying Hamas's tunnels was actually dictating the length of the entire campaign.[62] In one instance, a particularly deep tunnel that was discovered on the outskirts of the Israeli village of Netiv Haasara was flooded with seawater by the IDF in order to force the tunnel's collapse. Elsewhere, other IDF units utilised liquid explosives in a unique manner which was used to enable the destruction of the entire tunnel route at a faster pace than if standard explosives had been used.[63] Without the advanced technical capabilities of the Yahalom unit for demolition, non-specialist ground units innovatively used thousands of land mines which they strung together in chains that were lowered into tunnel shafts. They made simple but creative use of trolleys and agricultural equipment borrowed from nearby Israeli border villages to assist in the transport of large amount of explosives required to carry out the demolitions.[64] Notably, these improvised solutions devised by the other units were less effective than the 'official' techniques developed by the Yahalom unit, but helped the IDF speed up the overall process of tunnel demolition. As one retired IDF officer reflected, 'The question was not if the solutions would be perfect, but whether it would be good enough…People always expect war to play out like the movies – even generals don't understand the level of confusion and the slowing-down effect of friction and the issues that can never be completely planned for in advance.'[65]

## Battlefield lesson-learning systems

The entire lesson learning process was bolstered and enabled by the use of a formal IDF 'knowledge management' mechanism for real-time battlefield lesson-learning, which had been previously institutionalised and refined after the 2006 Lebanon War. The IDF's formalised lesson learning system relied on three central components which illustrates the dynamic interplay of learning process that occur at the 'top' and 'bottom' of the organisation. First, a digital army fibre-optic network and intranet system enabled real-time diffusion of lessons learned by units on the ground from the bottom-up. Second, 'Knowledge Officers' embedded within combat units on the ground from the battalion-level and higher were designated with transmitting lessons learned horizontally to other embedded 'Knowledge Officers'. These officers act as a core network among units and as bidirectional

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[62]Amos Harel, 'As Bulldozers Destroy Hamas Underground Network, IDF Sees Light at End of the Tunnel', *Haaretz*, 1 August 2014.
[63]Gili Cohen, 'IDF Soldiers Tasked with Tunnel Destruction Not Trained for Primary Mission', *Haaretz*, 7 August 2014.
[64]Harel and Cohen, 'Haaretz Probe'.
[65]Author interview with a retired senior IDF officer.

knowledge nodes to exchange lessons learned between units. Third, the dissemination of daily knowledge digests codified by IDF Ground Forces Command (GFC) from the top-down based on lessons learned from the prior day's battlefield experiences.[66] The role of GFC illustrates an inherent benefit of the military hierarchy for institutionalising lessons.

The learning process was enhanced by the Yahalom unit, who were on the front lines and acted as the driving force for the development of best practices for counter-tunnel warfare. Due to the small and 'intimate' size of the IDF, lessons were transmitted horizontally by the Yahalom unit to other ground units through informal networks and personal contacts. Lessons that were diffused by the Knowledge Officers were also transmitted to GFC's Centre for Army Lessons Learned based in IDF Southern Command, which formally codified and transmitted the lessons into explicit knowledge digests from the top-down. Knowledge Officers, with their open channel to GFC's Centre for Army Lessons Learned, were critical nodes of learning and often acted as the bridge between informal and formal learning processes. This illustrates the dynamic interplay of both top-down and bottom-up learning processes.[67]

In the aftermath of the 2014 conflict, in line with the IDF's culturally-compatible pattern of adaptation, the specialised Yahalom Unit has been bolstered to improve, refine and perfect tactics and procedures for subterranean warfare. There has also been a realisation in the IDF that every infantry unit needs an independent capability to handle subterranean tunnel threats, as recruits in infantry and paratrooper units are being trained on newly-built infrastructure to fight in such conditions.[68] As Col. (res.) Atai Shelach, a former commander of the Yahalom unit recently wrote: 'We should develop and subsequently preserve a situation where all of the relevant forces maintain a reasonable level of basic competence, so that when required, they will only need a brief period of refresher or specialised training in order to engage in combat or execute dedicated operational assignments.'[69] This exposure to basic tunnel training will help facilitate rapid adaptation in the future.

## 'Learning operations' to discover enemy capabilities

The IDF toyed with other methods and mechanisms to learn on the battlefield in 2014. The IDF had a little-known informal plan 'which called for the

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[66]For details, Steven Mains and Gil Ariely, 'Learning While Fighting: Operational Knowledge Management that Makes a Difference', *Prism* 2/3 (June 2011), 169–72; Marcus, 'Military Innovation and Tactical Adaptation in the Israel-Hizballah Conflict', 512–23.

[67]For case studies illustrating the dynamic interplay between top-down and bottom-up processes of change in the US Army in Iraq and the IDF in Lebanon, Russell, *Innovation, Transformation, and War*, 14–8; Marcus 'Military Innovation and Tactical Adaptation in the Israel-Hizballah Conflict', 503.

[68]Yossi Yehoshua, 'IDF to Create Smaller, Better-Trained Reserve Force', *Yediot Ahronot*, 22 March 2015.

[69]Atai Shelach, 'Demolition – From a Specialised "Boutique" Competence to Widespread Availability', *Israel Defense Magazine*, 10 June 2015.

employment of the first available brigade in an emerging conflict to carry out "Learning operations"' where the IDF 'would send a brigade into an area to fight and understand what is new in the battlefield. The unit's main task is to learn and report back relevant lessons about the environment'.[70] These units act as the 'tip of the spear' in order to enable the discovery of enemy capabilities, trigger the IDF's learning process and transmit relevant lessons to the rest of the IDF.

The IDF's notion of learning operations has explicitly drawn from a related concept developed by the Australian Army. The Australian Army adopted the use of 'Discovery Actions', which it defined in its army land doctrine as an operation designed to test or confirm its understanding of the battlefield, when a military force 'probes the system to learn. As an example, before committing to an attack on a defensive position small teams may go forward and probe the defences of the position to confirm their understanding of the defensive position and the likely enemy reactions to contact'. The Australian Army stated that because 'the dimensions of a problem are not fully known until we stimulate a response', an iterative process of discovery and learning is required to facilitate adaptation.[71] This type of operation resonates strongly with the timeless teachings of Sun Tzu, who urged the general to 'Rouse [your opponent] and learn the principle of his activity or inactivity. Force him to reveal himself, so as to find out his vulnerable spots.'[72]

'Discovery Action' is only the first principle of the Australian Army's 'Adaptation Cycle', which is comprised of four phases: Act, Sense, Decide and Adapt. After probing the enemy with a 'Discovery Action', the force must 'sense' or assess the opponent's reactions and develop measures of effectiveness for the force's response. Next, the force must 'decide' on an understanding of what the opponent's response means, potential ramifications, and elect what should be done. Finally, the force must 'adapt' by diffusing lessons learned between units involved in fighting, and also by focusing on how to recognise the need for change and understanding the inherent challenges associated with learning.[73]

The Australian Army's Adaptation Cycle was designed to complement John Boyd's famous OODA Loop (Observe, Orient, Decide, Act) by explicitly drawing out the requirements to learn and adapt while integrating mission command. The OODA loop 'emphasises the importance of orientation for making sense of the observed situation which is the basis for decision and action', and the Adaptation Cycle emphasises 'understanding a problem through experience, knowledge and planning, enhancing the understanding

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[70]Author interview with Brig. Gen. Meir Finkel.
[71]Australian Army, *Adaptive Campaigning: Army's Future Land Operating Concept*, (Canberra: Army Headquarters, Sept. 2009), 33.
[72]Sun Tzu, *The Art of War*, trans. Lionel Giles, (New York: Barnes and Noble Classics 2004), 112.
[73]Australian Army, *Adaptive Campaigning*, 33–35.

through interaction and explicitly drawing out the requirements to learn and adapt individually and organisationally.'[74]

The Israelis seem to have made an attempt to emulate the Australian concept and translated elements of the Australian concept in various IDF publications.[75] The concept was informally adopted by IDF GFC during the 2014 Gaza conflict in an effort to locate the entrance shafts of Hamas tunnels, dubbed as 'Stimulus-Response Operations' in the IDF.[76] It is important to note that while operations designed to garner lessons about an enemy's hidden capabilities is *not* a new notion in warfare, the use of these kinds of operations in the 2014 conflict reflects the IDF's concerted effort over the prior decade to institutionalise a pre-planned, systematic mechanism to trigger learning 'under fire'.[77] These 'learning operations' were combined with conventional methods to locate Hamas tunnels: the IDF used pinpoint intelligence and also conducted intensive ground sweeps in Gaza in an effort to uncover tunnels. The 'learning operations' were designed to get Hamas to respond to IDF actions in an effort to help reduce the area that IDF ground forces needed to sweep to locate tunnel openings.[78]

Most of the IDF's responses to the Hamas tunnels were based on improvised solutions developed by units in the field, which illustrates the need for armies to embrace learning upon encountering the enemy in the opening of combat. In line with Clausewitz's point about the importance of combat experience in enabling soldiers' ability to cope with battlefield friction, as pointed out by Brig. Gen. Meir Finkel, Head of the IDF's Military Studies Centre:

> The first operations against the offensive tunnels in Operation Protective Edge, although not defined as a 'Learning operation', were indications of the implementation of this idea. As illustrated by this operation, there are situations where there is no substitute for friction in order to deal with operational problems to turn information into understanding, both in terms of the individual character of the problem and about the response.[79]

## Conclusions

Col. Tomer Ifrach, an IDF brigade commander involved in the fighting during the 2014 war recently reflected, 'The greatest question asked each time a campaign is embarked upon is: Were you surprised? As if surprise means failure. Surprises are a part of war. The question is who recovers first.'[80] The

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[74]Australian Army, *Adaptive Campaigning*, 31.
[75]For example, 'Adaptive Campaign', *Tatzpit* no.69, (IDF: Training and Doctrine Command, 2011) [Hebrew]; Finkel, 'Operational Learning in the Opening of Combat', 18–19.
[76]Finkel, 'Operational Learning in the Opening of Combat', 19.
[77]Author interview with a retired senior IDF officer.
[78]Author interview with a retired senior IDF officer.
[79]Finkel, 'Operational Learning in the Opening of Combat', 19.
[80]Matan Tzuri, 'The Colonel's Tunnel War', (Interview with Col. Tomer Ifrach) *Yediot Ahronot*, 22 October 2016.

IDF's experience in Gaza highlights several attributes and organisational traits that bolstered its 'organisational learning capacity' and ability to adapt: culture, mission command, a mechanism and 'incubator' for learning, and a system for dissemination of lessons.[81] These attributes helped the army effectively respond to battlefield surprise and facilitated learning and adaptation. Israeli military culture and its 'doer' ethos have historically enabled operational risk-taking, which led to experimentation and improvisation by ground units in Gaza without fear of punishment for failure. The IDF's technological skill, resourcefulness, initiative and ability to improvise are dependent on the qualitative societal characteristics from which the soldiers are drawn, which inherently affects organisational patterns and modes of adaptation.[82]

Enabled by its open, dynamic, action-oriented organisational culture, the IDF's improvised efforts to the tunnel surprise were often spearheaded by its specialised commando units. The IDF's commando forces acted as 'integrators' that linked and bolstered other ground units, due to the enhanced capabilities, procedures and organisational forms that are at the core of special operations.[83] Learning was enabled by the IDF's decentralised leadership and adherence to mission command, as various counter-tunnel adaptations were developed independently by soldiers operating on the ground with little oversight from senior command. This facilitated the development of improvised solutions by the various special forces units called in to help compensate for the shortage of counter-tunnel units. The Yahalom unit acted as an 'incubator' for experimentation and innovation and horizontally transmitted best practices and lessons learned through both informal briefings and formal trainings given during the conflict. The IDF's formal knowledge management system, overseen by IDF GFC, also functioned effectively to enable top-down and bottom-up learning and facilitated the diffusion and institutionalisation of lessons learned about Hamas's tactics and capabilities.

Despite continued sharp criticism from within the IDF for its own failings to internalise an 'understanding' of the threat from the Hamas tunnels prior to the war,[84] the limitations of intelligence prediction are well-known. Leaked revelations from an Israeli State Comptroller Report examining Israel's readiness for war in 2014 pointedly blamed the political echelon, particularly Prime Minister Netanyahu for not sharing intelligence obtained from the IDF about the tunnel threat with the Security Cabinet, and Defence Minister Yaalon for

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[81]Frank G. Hoffman 'Mars Learning and Adapting,' Powerpoint presentation, Center for Strategic Research, National Defense University, Washington DC, 31 May 2016.

[82]Meir Finkel, *On Flexibility: Recovery from Technological and Doctrinal Surprise on the Battlefield* (Stanford: Stanford UP, 2012), 12; Horowitz, 'Flexible Responsiveness and Military Strategy', 191–2.

[83]Shamir and Ben-Ari, 'The Rise of Special Operation Forces', 21.

[84]Sini Libel, 'Response to Learning Before Fighting' *Maarachot* no.458 (Dec. 2014), 64–5 [Hebrew].

not sufficiently ensuring that the army was preparing a response. Lesser criticism was directed at the IDF for not conveying the extent of tunnel threat and for not more aggressively ensuring that the Cabinet was warned.[85] A separate internal IDF probe criticised the army top brass for not carrying out adequate training or preparation to counter the tunnel threat which was well-known to much of Military Intelligence.[86]With the release of the State Comptroller's report in Feb. 2017 and the 'blame game' that erupted, these debates in Israel are far from being resolved. Hence, rather than strengthening intelligence capabilities or reflexively replacing unit training officers, the most effective objective for the IDF for future conflict is on further developing the capacity to learn and adapt at the opening of conflict both quickly and efficiently. Such a mode of learning and adaptation complements the IDF's strategic culture, its historical pattern of military adaptation, provides a remedy to cope with battlefield friction, and maximises the IDF's qualitative advantage which is reliant on its 'human capital'.[87]

In line with 'organisational learning capacity',[88] effective adaptation by soldiers on the ground is most likely in a qualitatively-superior military like the IDF, with its versatile, flexible organisational structure and flattened and informal hierarchies that promote mission command principles.[89] Furthermore, successful improvisation and adaptation are more likely if a military emphasises sensible and flexible force-planning and doctrine development, technological versatility and officer education grounded in a military culture which promotes problem solving and agile thinking. A learning-oriented military culture, flexible command structure, and a balanced, non-monolithic military doctrine that takes into account diverse types of warfare are of utmost importance.[90] The final piece of the puzzle regarding augmenting a military's flexibility and ability to adapt 'under fire' is an organisational culture that promotes creativity, problem solving and lesson learning at all levels of the organisation.

Lesson learning is an essential component of all military operations occurring at the top and bottom of the organisation and related knowledge management programs have gained major traction in Western militaries over the last few years. Notably, the US Army has recently published a refined version of its 'Knowledge Management' doctrine in order to enhance its ability to capture and disseminate lessons learned, augment its institutional knowledge repository, and bolster its real-time decision-making capabilities.[91] The British army

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[85]Itamar Eichner et al., 'State Comptroller: PM Withheld Information from Cabinet regarding Gaza Tunnel Threat', Yediot Ahronot, 18 November 2016.
[86]Gili Cohen, 'IDF Top Brass Failed to Grasp Hamas Tunnel Threat during 2014 Gaza War, Internal Probe Charges', Haaretz, 18 October 2016.
[87]Finkel, 'Operational Learning in the Opening of Combat', 19.
[88]Hoffman, 'How We Bridged a Wartime Gap'.
[89]Shamir, Transforming Command, 82–95.
[90]Finkel, On Flexibility, 2–4.

has refined its 'Army Knowledge Exchange' and related lesson-learning programs, but support has been somewhat subdued since the army's withdrawal from Afghanistan in 2014.[92] The Australian, Canadian and French armed forces are also grappling with efforts to institutionalise doctrinal and structural flexibility and organisational agility and have made significant efforts to formalise various lesson-learning systems which enhance the army's ability to learn, diffuse lessons and adapt on the battlefield.[93] Innovative training regimens like the IDF's program that trains soldiers to cope with mental, cognitive and physical issues related to responding to surprise on the battlefield is a novel way to implement adaptability and enhance a military's ability to learn under fire. As Clausewitz noted, 'To plan maneuvers so that some of the elements of friction are involved, which will train officers' judgment, common sense, and resolution is far more important than inexperienced people might think.'[94] Only a commander's intuition gained through combat experience, and his flexibility, leadership, training and 'iron willpower' will enable soldiers to cope with friction in war and ultimately enhance their ability to adapt and improvise 'under fire.'[95]

## Acknowledgments

## Disclosure statement

## Notes on contributor

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[92]Personal communication with a former analyst in the British Army's Lessons Exploitation Centre (LXC), 22 June 2016; On lesson-learning in the British army, Foley *et al.*, 'Transformation in Contact', 259–65; Catignani, 'Coping with Knowledge.'
[93]For an Australian example, Paddy O'Toole and Steven Talbot, 'Fighting for Knowledge: Developing Learning Systems in the Australian Army' *Armed Forces and Society* 37/1 (2011), 42–67.
[94]Clausewitz, *On War*, 122.
[95]Alan Beyerchen, 'Clausewitz, Nonlinearity, and Unpredictability of War', *International Security* 17/3 (Winter 1992/93), 76.

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